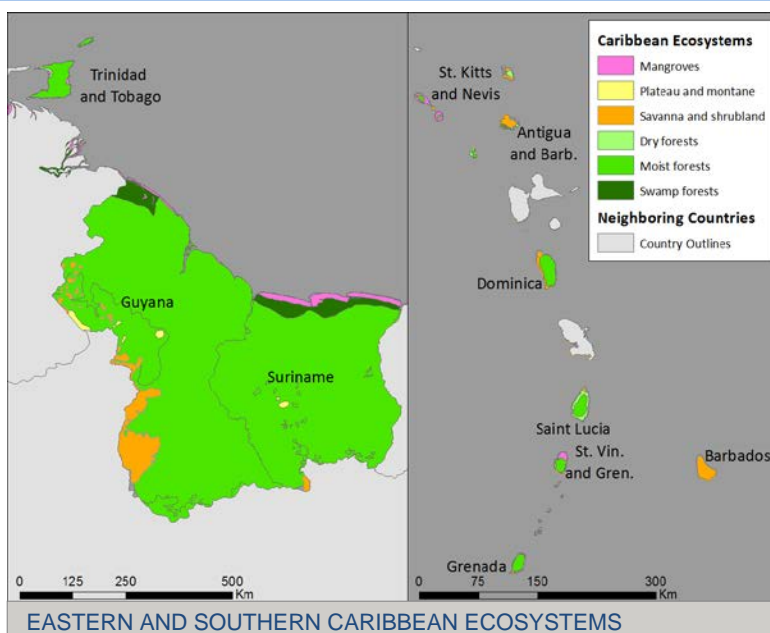


CLIMATE RISK PROFILE EASTERN AND SOUTHERN CARIBBEAN

REGION OVERVIEW

USAID's development assistance in the Eastern and Southern Caribbean region extends to 10 countries: Antigua and Barbuda, Dominica, Grenada, St. Lucia, St. Vincent and the Grenadines, St. Kitts and Nevis, Barbados, Trinidad and Tobago, Suriname, and Guyana. The high vulnerability to, and potential for, climate impacts throughout the region often drives direct integration of climate risk management into country and regional planning and processes. However, development and capacity levels vary throughout the region, as do the industries central to each economy. Rates of poverty range from as low as 9% in Barbados to as high as 70% in Suriname. For most of the island countries, tourism is the largest industry, though exports most heavily drive



gross domestic product (GDP) in Trinidad and Tobago (oil and gas; 40%), Guyana (sugar, gold, bauxite, shrimp, timber, and rice; 60%), and Suriname (oil and gold; 65%). Despite varied topography throughout the region, with some islands small and flat and others mountainous, the countries share many climate vulnerabilities and risks. Population and key infrastructure are typically in coastal areas, facing increased risk from tropical storms and sea level rise. Quantity and quality of both surface- and groundwater may be compromised by changing rainfall patterns and sea level rise. Ocean warming and acidification threaten coastal ecosystems, such as coral reefs and mangroves. The smaller island countries are most vulnerable to sea level rise and salt water intrusion, and the region's northern islands are frequently affected by hurricanes and tropical storms, with three significant hurricanes and one tropical storm hitting the region in 2017. Hurricane Irma damaged or destroyed 95% of properties in Barbuda. In Dominica, Hurricane Maria caused 31 deaths as of November 2017 and led to about \$1.37 billion in damages and losses (226% of GDP) including widespread water and power loss (3,8,11,26,27,28,29,30,31,32,33,34,35)

CLIMATE PROJECTIONS



0.9–1.3° C increase in temperatures by 2050



Increase in hurricane intensity, including stronger winds and more precipitation



Rising sea levels and increased incidence of storm surge

KEY CLIMATE IMPACTS

Coastal Resources

Damaged infrastructure
Decreased access to services
Degraded coastal ecosystems



Health

Shifting infectious disease burden
Increased heat stress
Lack of access to health services



Water Resources

Decreased water quantity and quality
Damage to infrastructure due to increased intensity of storms and sea



Tourism

Degraded coastal ecosystems
Damaged infrastructure
Increased difficulty delivering services



Fisheries

Habitat degradation and loss
Biodiversity loss
Changing fish migration patterns



Agriculture

Crop loss or failure
Loss of land and water resources for irrigation



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CLIMATE SUMMARY

The region's topography varies from low-lying coral islands like Barbuda, with a maximum elevation of 42 meters (m), to volcanic islands with mountainous interiors like St. Kitts and Nevis and Dominica, with maximum elevations of 1,156 m and 1,447 m, respectively. On the South American mainland, Guyana and Suriname are covered in swamps, mountains, savannah and rich tropical forests. Average annual precipitation throughout the region is 2200 millimeters (mm) or higher, but varies widely. For example, some areas of Guyana receive 3,500 mm annually, while Antigua receives 1,200 mm annually. All countries in the region experience drought conditions. Guyana and Suriname have humid climates and two wet seasons: the primary from May to July, and another lesser rainy season from November to January. The climate on the coasts is humid and warm with high temperatures averaging 32°C in the hottest month (July) and 29°C in the coolest month (February), and lows averaging 24°C and 23°C, respectively. Further into the interior, particularly in Guyana, the climate cools due to an increase in altitude, with recorded nighttime readings as low as 12°C. Caribbean island nations have a tropical climate with one rainy season, from May to November (3,8,11,17,20).

HISTORICAL CLIMATE

Climate trends include the following:

- Average annual temperatures have increased 0.2-0.7°C, varying by country. (The maximum increase occurred in St. Vincent and the Grenadines, the minimum in Suriname.)
- Changes to average annual rainfall vary within the region. In St. Vincent and the Grenadines, precipitation has decreased by 8.2 mm (-5.7%) per decade since 1960. In Guyana, monthly precipitation has increased by 4.8 mm per month per decade since 1960. Regionally, there may be a decrease in rainy days and a slightly shorter rainy season.
- The frequency of hot days¹ has increased in many, but not all, of the countries.
- There has been a substantial increase in the intensity of Atlantic hurricanes since 1980.
- The mean rate of sea level rise in the Caribbean was about 1.8 (+/- 0.5) mm per year from 1962- 2012. (26,27,28,29,30,31,32,33,34)

FUTURE CLIMATE

Projected changes are as follows:

- In most of the region, an increase in average annual temperature of 0.9-1.3°C by 2050 is likely.
- In Dominica, an increase in hot days, with projections indicating that hot days will occur on 25%–65% of days annually by the 2060s. Similar numbers are projected for St. Vincent and the Grenadines and St. Kitts and Nevis.
- In the island nations, cold weather events are anticipated to disappear by 2060.
- Changes in precipitation are projected to vary throughout the region. In St. Lucia, there is a projected 15%–20% decrease in precipitation. A decrease in rainfall of up to 29% is anticipated in parts of Guyana. In Dominica, precipitation is expected to decrease in all months except May, June, and July.
- Frequency of category 4 and 5 hurricanes expected to increase by 25%–30%. (17,26,27,28,29,30,31,34,36)

SECTOR IMPACTS AND VULNERABILITIES

AGRICULTURE

Agriculture is a critical component of the economies of some of the countries in the Caribbean. In Dominica, agriculture is responsible for 17% of the GDP and 40% of employment; in Guyana, agriculture accounts for 17% of GDP. It accounts for 12% of GDP in Suriname and 9% in Grenada, and 7.1% in St Vincent and the Grenadine. The role of agriculture in the economies of the other islands is less significant.² Agriculture in the Caribbean, even without climate change, already faces significant challenges: most farms are small and

¹ Days with temperatures greater than 35°C

² Percent GDP contribution of the Agricultural Sector: St Lucia 2.9%; Antigua and Barbuda, 2.3%; St Kitts and Nevis, 1.1%; Trinidad & Tobago 0.2%.

fragmented, industrial farming has become less profitable, agricultural labor costs are high, agricultural populations are aging, and traditionally grown crops lack diversity. Climate change will make an already brittle agriculture sector even more fragile. Stronger storms and hurricanes will increase the frequency of crop failure and the degree of crop losses beyond current levels. The 2017 hurricanes destroyed almost all crops on the affected islands, requiring re-planting for the season. Stronger storms will also likely cause an increase in soil erosion and landslides. In some countries, drought is likely to be more prevalent, which could decrease yields. Sea level rise and saltwater intrusion can damage crops in low-lying areas. Some countries use rain water catchment systems, which are a good tool to help communities access water needed for agriculture. However, these systems are only effective at the community scale, usually require reserve water supplies due to climate variability, and are insufficient for larger farms. In addition to decreased productivity, climate change and variability could impact other aspects of the value chain, such as increased temperatures making storing seeds or crops more difficult or exporting crops less certain in the case of increased intensity of tropical storms. (3,12,13,16,22,24)

Climate Stressors and Climate Risks AGRICULTURE	
Stressors	Risks
Increased storm frequency and strength	Soil erosion and loss of soil fertility
	Storm damage to crops and livestock
Saline intrusion	Increased flooding and mudslides
	Unpredictable growing seasons
Increased drought	Water shortage
	Crop waterlogging, damage, and/or failure

WATER RESOURCES

Water resources in the region vary considerably between countries. Some countries have extensive river systems with plentiful freshwater resources, and others have dry climates and more limited access to water. Because many of the islands are small, and some are primarily porous limestone, both surface water and groundwater sources can be limited, as well as vulnerable to pollution and salt water intrusion. Poor sanitation infrastructure, for example, can cause contamination of surface- and groundwater. The entire region has faced drought-like conditions since 2015, but Barbados and Antigua and Barbuda, which lack water resources, are particularly vulnerable to water scarcity. Countries that have not typically lacked water resources, like St. Kitts and Nevis, are also facing more water scarcity issues. Furthermore, during El Niño/Southern Oscillation events the region typically experiences drought. To adapt, Barbados currently relies on saltwater desalinization plants to provide fresh water; water use in 2014 was 101% of available freshwater resources. Antigua and Barbuda also use desalinization to meet their water needs. Climate variability and change pose significant threats to an already stressed water sector. Limited reservoir size makes many areas, especially the mountainous islands, vulnerable to floods and landslides during extreme rain events. Floods and landslides can decrease the availability or accessibility of quality water, through contamination and infrastructure damage. Sea level rise and storm surge could introduce saline water into freshwater resources in low-lying areas. Damage to water and sanitation infrastructure during hurricanes will likely increase as storms become stronger and more frequent. Additionally, the threat of increased drought in some islands, and in regions of Guyana and Suriname, will likely further limit the existing availability of fresh water, as will tourism and urbanization, which have increased pressure and stress on water resources. (14,20,27,30,34,35).

Climate Stressors and Climate Risks WATER RESOURCES	
Stressors	Risks
Sea level rise	Salt water intrusion into aquifers
Increased drought	Decreased water availability
Increased storm frequency, intensity and surge	Increased damage to water infrastructure
	Increased contamination of reserves and reservoirs

COASTAL RESOURCES

Much of the population and infrastructure are located along the coast in these 10 countries, including the mainland countries of Suriname and Guyana. Thus, anticipated sea level rise of 17 to 44 centimeters by 2050, combined with greater risk of flooding due to increased tropical storm strength, will put significant stress on infrastructure and population centers. For example, in Barbuda, category 5 Hurricane Irma destroyed or damaged nearly 95% of all structures on the island in 2017. Early estimates place costs of rebuilding Barbuda at \$220 million. Hurricane Maria displaced 17,000 people in Dominica, resulted in 31 deaths and 35 missing persons (as of November 2017), and caused \$1.37 billion in damages and losses (226% of GDP). Irma, Maria, and other hurricanes and tropical storms have also severely damaged or destroyed ecosystems and their associated services, and, in some cases, led to the deterioration of security. Energy and transportation infrastructure, including ports and roads, are particularly at risk of damage from tropical storms and sea level rise. Preventative adaptation techniques can be used to limit the impact of sea level rise, storm surge, and increased storm intensity to coastal infrastructure and ecosystems. Coastal ecosystems are at risk due to increased ocean temperatures, ocean acidification, and increased intensity of storms. Coral bleaching, primarily caused by increased ocean temperatures, will likely lead to death and shrinkage of coral reefs surrounding many Caribbean islands. Ocean acidification presents a significant threat to all aquatic crustaceans, including shellfish important to local fisheries. Coral reefs serve as a critical barrier to erosion and storm surge, and their degradation will further threaten the beaches and shores of many of the islands and the coasts of Guyana and Suriname. (1,10,11,15,26)

Climate Stressors and Climate Risks COASTAL RESOURCES	
Stressors	Risks
Sea level rise	Damage to civic infrastructure, homes, and businesses
Increased storm frequency, intensity, and surge	Decreased access to energy
	Damage to local ecosystems, including mangroves and coral reefs (e.g., bleaching)
Ocean acidification	Increased erosion
Ocean warming	Decreased security in population centers

HEALTH

Climate variability and change has the potential to adversely affect health in the Eastern and Southern Caribbean in multiple ways. Increased storm frequency risks human health through the harm and deaths inflicted during the storm and infrastructure critical to health service delivery (e.g., hospitals, roads, clean water, and electricity), and creates an environment in which disease vectors like rodents and mosquitos can flourish. Diseases carried by the *Aedes aegypti* mosquito, including dengue fever and Zika, are common in this region, and may become more prevalent with increased temperatures or more standing water after rain events. Rainwater storage systems, for instance, may act as common breeding areas for *A. aegypti* without the proper preventative measures. Further, after hurricanes, Caribbean communities have experienced outbreaks in water-borne diseases, as in 2003 in Trinidad and Tobago. Many countries feared cholera outbreaks following the 2017 hurricane season, though to date, there is no evidence of such an outbreak. There is also potential for increased heat waves, which can exacerbate heat stress, resulting in respiratory, skin, or eye disease, and even death. (9,14,25)

Climate Stressors and Climate Risks HUMAN HEALTH	
Stressors	Risks
Water scarcity	Increase in water- and vector-borne diseases
Increased storm frequency and intensity	Death and injury
	Lack of access to services
Increased heat	Damage to health infrastructure

TOURISM

Tourism in the region is primarily driven by the natural beauty, pleasant climate, tourism-specific infrastructure and amenities, beaches, and coral reefs prevalent throughout the Caribbean. Climate variability and change threaten these features. Because of the centrality of the beach experience to Caribbean tourism, most hotels and resorts are located close to the ocean and are low-lying. Additionally, the transportation, energy, and water infrastructure critical to a thriving industry are vulnerable to sea level rise and increased storm threats. The increased frequency of droughts in many of the Caribbean countries leaves the tourism industry vulnerable to water shortages. Large-scale coral bleaching caused by rising ocean temperatures could leave the coral reefs less desirable to divers and snorkelers, decreasing their likelihood of visiting the region. (10)

Climate Stressors and Climate Risks TOURISM	
Stressors	Risks
Increased drought	Increased water scarcity
	Damage to infrastructure and tourism businesses
Increased storm frequency and intensity	Beach erosion
Ocean acidification	Decreased fish population and visitation from scuba divers and snorkelers
Ocean warming	Coral bleaching

FISHERIES

The fisheries sector comprises only a small part of the regional economy, accounting for approximately 2% to 5% of the GDP of most of the small island nations in the Caribbean. However, fish stocks within the region are important for the maintenance of traditional livelihoods, as a source of protein for local communities, and as a tourism attraction for scuba divers, snorkelers, and sport fishermen. There is evidence that tropical fish are migrating towards the poles as oceans warm, with parrot fish, snapper, and grouper, among others, found with increasing prevalence in the northern Gulf of Mexico and along the Atlantic seaboard. Large-scale fishing is a part of the economy in Barbados, Grenada, and St. Kitts and Nevis, but elsewhere, fishing is predominantly at a small, community scale. Many of the region's fish stocks rely on the coral reefs and mangroves

Climate Stressors and Climate Risks FISHERIES	
Stressors	Risks
Coral bleaching due to ocean warming	Deterioration in coral reef habitat
	Decreases in migrating fish populations
Ocean acidification	Impact on other animals that rely on fish
Increased frequency and strength of storms	Loss of community livelihoods and impacts to community food security
	Loss of equipment and investments

surrounding the islands. Much of the coral in the Caribbean has bleached due to increased ocean temperatures leaving it vulnerable to starvation, reduced growth rates, disease, infertility, or death. With continued climate change, further increases in ocean temperatures will threaten the symbiotic relationship necessary for coral survival, and ocean acidification due to carbon dioxide absorption will harm crustaceans, mollusks, and other ocean life. According to some projections, most Caribbean coral reefs could bleach during the next 30 to 50 years. As corals bleach and die, and as ocean acidification increases, suitable habitat for shellfish, spiny lobster, conch, and other high-value catches will decrease. Habitat loss will likely exacerbate existing pressures on fish stocks from overfishing and degraded water quality. Sea level rise threatens mangrove ecosystems, which serve as important breeding ground for marine life, and act as a natural barrier to storm surge and flooding. Furthermore, the impacts on the coastal ecosystem will have effects up the food chain, including on birds, porpoises, and larger migrating fish such as tuna, disturbing fisheries and ecotourism. Fishing boats, nets, and other equipment are vulnerable to damage during storm events. Increased storm intensity and frequency will likely cause significant losses of investment among fishing companies and communities and will slow economic recovery after a disaster. (10,13,18,19)

POLICY CONTEXT

Caribbean countries are largely aware of the threats of climate variability and change and have undertaken actions to adapt. Within the 10 nations served by the USAID Eastern and Southern Caribbean Mission, capacity to limit risks associated with climate change varies. The Caribbean Community (CARICOM) is the primary multilateral body of Caribbean states and was established in 1973 with the following goals: economic integration, foreign policy coordination, human and social development, and security. CARICOM has 15 member states, including all 10 states supported by USAID in the Eastern and Southern Caribbean.

INSTITUTIONAL FRAMEWORK

As a region made up primarily of island nations directly affected by climate change, many of the individual nations have institutions and strategies dedicated to addressing climate risks. Grenada even has a clause in an amendment to its constitution that says the state will “protect the country against adverse effects of climate change.” CARICOM also made “building environmental resilience” one of its strategic priorities for 2015-2019, focusing primarily on climate resilience. The Caribbean Community Climate Change Center (CCCCC), which is part of CARICOM, coordinates the region’s response to climate change adaptation and mitigation. The Caribbean Institute of Meteorology and Hydrology (CIMH) is a capacity building body that provides training, research, investigations, and services to Caribbean member states. The Caribbean Disaster Emergency Management Agency (CDEMA) coordinates response to disasters in the region and incorporates climate change into planning. Various sectors, such as the energy and agriculture sectors, also have a regional focus under CARICOM that integrates climate resiliency, particularly in response to natural disasters. (4,5,6,7)

STRATEGIES AND PLANS

- [Climate Change Adaptation Program \(CCAP\)—2016–2020](#)
- [CARICOM Nationally Determined Contributions](#) (2017)
- [Caribbean Regional Strategic Program for Climate Resilience](#) (2012)
- [Agreement Establishing the Caribbean Disaster Emergency Management Agency](#) (2008)
- [The Implementation Plan for CARICOM ‘Regional Framework for Achieving Development Resilient to Climate Change’](#) (2011–2021)

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Data for map sourced from: World Wildlife Fund Terrestrial Ecoregions of the World (<https://www.worldwildlife.org/pages/conservation-science-data-and-tools>)

SELECTED ONGOING EXPERIENCES

Below are selected projects focused on climate change adaptation, or some aspect of it, in the Caribbean region.

Selected Program	Amount	Donor	Year	Implementer
Testing a Prototype Caribbean Regional Fund for Wastewater Management (CReW)	USD 273 million	Global Environment Facility	2011–2015	UN Environment, Interamerican Development Bank
Climate Action Line of Credit (CALC)	USD 191 million	European Investment Bank and Caribbean Development Bank	2011–ongoing	Caribbean Development Bank
Community, Family and Youth Resilience Program	USD 38.1 million	USAID	2016–ongoing	Creative Associates
Caribbean HIV/AIDS Prevention and Elimination (HoPE) Project	USD 46 million	USAID	2015–ongoing	Various
Organization of Eastern Caribbean States (OECS) Regional Tourism Competitiveness	USD 26 million	The World Bank	2017–ongoing	International Development Association
Climate Change Adaptation Program (CCAP—2016–2020)	USD 10.0 million	USAID	2016–2020	CCCCC
OECS Regional Agriculture Competitiveness Project	USD 9.66 million	The World Bank	2017–ongoing	International Development Association
Multi-Dimensional Approaches to Poverty Eradication in the Eastern Caribbean Project (MDAPP)	USD 1 million	Government of Chile	2015–2017	OECS Commission
Programme on Integrated Climate Change Adaptation Strategies (ICCAS)	EUR 5 million	Deutsche Gesellschaft für Internationale Zusammenarbeit, UN Development Programme	2013–2018	Government of Grenada
Japan-Caribbean Climate Change Partnership	USD 15 million	Japan International Cooperation Agency	2015–ongoing	Government of Japan and UNDP
2014-2018 Coastal Protection for Climate Change Adaptation in the Small Island States in the Caribbean		German Ministry for Economic Cooperation and Development	2014–2018	CCCCC